7. a. $\begin{bmatrix} 5.00 & 8.00 \\ 3.50 & 4.75 \\ 3.50 & 4.00 \end{bmatrix}, \begin{bmatrix} 0.50 & 0.75 \\ 0.50 & 0.25 \\ 0.50 & 0.25 \end{bmatrix}, [43 \quad 81 \quad 37]$

b. Add the matrix of current prices and the matrix of price increases.

$$\begin{bmatrix} 5.00 & 8.00 \\ 3.50 & 4.75 \\ 3.50 & 4.00 \end{bmatrix} + \begin{bmatrix} 0.50 & 0.75 \\ 0.50 & 0.75 \\ 0.50 & 0.25 \end{bmatrix} = \begin{bmatrix} 5.50 & 8.75 \\ 4.00 & 5.00 \\ 4.00 & 4.25 \end{bmatrix}$$

c. Multiply the attendance matrix by the new price matrix calculated in 7b.

$$[43 \quad 81 \quad 37] \begin{bmatrix} 5.50 & 8.75 \\ 4.00 & 5.00 \\ 4.00 & 4.25 \end{bmatrix} = [708.5 \quad 938.5]$$

The revenue from a matinee will be \$708.50. The revenue from an evening show will be \$938.50.

8. a. Kayo was jogging fastest between points *A* and *B* because she covered a lot of distance in a short period of time.

b. Kayo was not moving; perhaps she was resting.

c. Possible answer: Kayo started out jogging fast but had to rest for a few minutes. Then she jogged much slower until she had to rest again. She finally got the energy to jog all the way home at a steady pace without stopping.

9. a. 2,900,000

b. (*See graph at bottom of page.*)

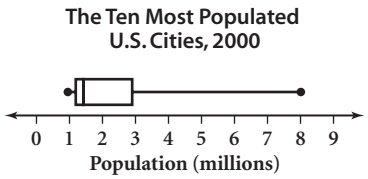
c. **The Ten Most Populated U.S. Cities, 2000**

0	95
1	14 19 22 32 52 95
2	90
3	69
4	
5	
6	
7	
8	01

Key

2 | 90 means 2.90 million

d.



e. The bar graph helps show how each city compares with the others, since they remain identified by name. The stem plot shows distribution, but also shows actual values. The box plot shows distribution and a clustering between 1 and 1.4 million, but does not show individual city names or populations.

10. a. Mean = 416.875 min

b. Median = 425 min **c.** Mode = 480 min

Take Another Look

The picture bar graph uses both a broken vertical axis (starting at 15) and pictures with decreasing area to exaggerate the decline of green space. The normal bar graph, on the other hand, measures only acres and neglects the ratio to the increasing population, which the first bar graph does. Therefore, both of the bar graphs are engineered to persuade. Answers will depend on whether you think acres per person or total acres is a better measure.

CHAPTER 2

LESSON 2.1

Exercises

1. Increasing order: b, a, d, c

Decimal values:

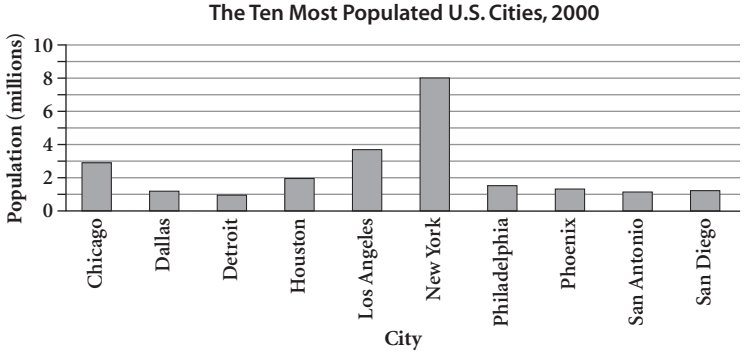
a. $\frac{7}{8} = 0.875$ **b.** $\frac{13}{20} = 0.65$

c. $\frac{13}{5} = 2.6$ **d.** $\frac{52}{25} = 2.08$

2. a. There are fourteen 9th graders (9 + 3 + 2). Nine of the 9th graders have brown eyes, so the ratio is $\frac{9}{14}$.

b. $\frac{11}{20}$ **c.** $\frac{4}{3}$ **d.** $\frac{3}{30}$, or $\frac{1}{10}$

Chapter 1 Review, Exercise 9. b.



3. a. $\frac{240 \text{ mi}}{1 \text{ h}}$

b. 10 ppm means 10 parts per million—in this case, 10 parts capsaicin to 1,000,000 parts water. This can be written $\frac{10 \text{ parts capsaicin}}{1{,}000{,}000 \text{ parts water}}$, or $\frac{1 \text{ part capsaicin}}{100{,}000 \text{ parts water}}$.

c. $\frac{350 \text{ women-owned firms}}{1000 \text{ firms}}$, or $\frac{7 \text{ women-owned firms}}{20 \text{ firms}}$

d. $\frac{35{,}500 \text{ dollars}}{1 \text{ person}}$

4. a. To solve $\frac{24}{40} = \frac{T}{30}$ for T, multiply by 30 to undo the division.

b. To solve $\frac{49}{56} = \frac{R}{32}$ for R, multiply by 32 to undo the division.

c. To solve $\frac{M}{16} = \frac{87}{232}$ for M, multiply by 16 to undo the division.

5. a.
$$\frac{24}{40} = \frac{T}{30}$$
$30 \cdot \frac{24}{40} = T$ Multiply by 30 to undo the division.
$18 = T$ Multiply and divide.

b. $R = 28$

c.
$$\frac{52}{91} = \frac{42}{S}$$
$\frac{91}{52} = \frac{S}{42}$ Invert both sides.
$42 \cdot \frac{91}{52} = S$ Multiply by 42 to undo the division.
$73.5 = S$ Multiply and divide.

d. $x = 2.1$

e. $\frac{M}{16} = \frac{87}{232}$
$M = \frac{87}{232} \cdot 16$ Multiply by 16 to undo the division.
$M = 6$ Multiply and divide.

f. $\frac{6}{n} = \frac{62}{217}$
$\frac{n}{6} = \frac{217}{62}$ Invert both sides.
$n = \frac{217}{62} \cdot 6$ Multiply by 6 to undo the division.
$n = 21$ Multiply and divide.

g. $c = 31.2$

h. $W = 9$

6. a. The ratio of the amount the ant can carry to the ant's weight would be equal to the ratio of the amount the student could carry to the student's weight. Let x be the amount the student could carry, and then write and solve a proportion.
$$\frac{4 \text{ g}}{1.5 \text{ g}} = \frac{x \text{ kg}}{55 \text{ kg}}$$
$55 \cdot \frac{4}{1.5} = x$ Multiply by 55 to undo the division.
$146.\overline{6} = x$ Multiply and divide.
The student could carry about 147 kg (about 323 lb). (Note: The proportion above is only one possibility. In this and other parts of this exercise, there are several proportions that also lead to the correct solution. For example, the ratio of the ant's weight to the student's weight is equal to the ratio of the amount the ant can carry to the amount the student can carry.)

b. The ratio of the ant's stride to the ant's length would be equal to the ratio of the student's stride to the student's height. Let x be the length of the student's stride, and then write and solve a proportion.
$$\frac{0.84 \text{ cm}}{1.27 \text{ cm}} = \frac{x \text{ m}}{1.65 \text{ m}}$$
$1.65 \cdot \frac{0.84}{1.27} = x$ Multiply by 1.65 to undo the division.
$1.09 \approx x$ Multiply and divide.
The student would have strides about 1.09 m long.

c. The ratio of the distance the ant travels to the ant's length would be equal to the ratio of the distance the student travels to the student's height. Let x be the distance the student travels, and then write and solve a proportion.
$\frac{0.4 \text{ km}}{0.0127 \text{ m}} = \frac{x \text{ km}}{1.65 \text{ m}}$ Change cm to m so that both denominators are in the same unit.
$1.65 \cdot \frac{0.4}{0.0127} = x$ Multiply by 1.65 to undo the division.
$52 \approx x$ Multiply and divide.
The student would travel about 52 km (about 32 mi).

7. a. $\frac{5}{2} = \frac{25}{10}, \frac{2}{10} = \frac{5}{25}, \frac{25}{5} = \frac{10}{2}$

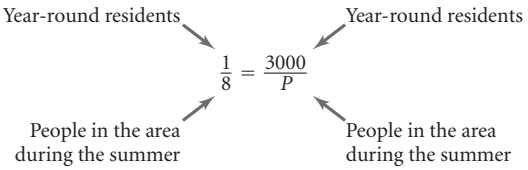
b. $\frac{9}{a} = \frac{27}{12}, \frac{a}{12} = \frac{9}{27}, \frac{27}{9} = \frac{12}{a}$

c. $\frac{k}{j} = \frac{m}{l}, \frac{j}{l} = \frac{k}{m}, \frac{m}{k} = \frac{l}{j}$

8. a. If 15% is withheld, Jeremy gets to keep 100% − 15%, or 85%.

b. 85% means 85 out of 100. So the ratio of Jeremy's hourly take-home wage t to his hourly wage is equal to $\frac{85}{100}$. You can find the value of t by writing and solving a proportion.
$$\frac{t}{7.38} = \frac{85}{100}$$
$t = \frac{85}{100} \cdot 7.38$ Multiply by 7.38 to undo the division.
$t = 6.273$ Multiply and divide.
Jeremy's hourly take-home pay is $6.27.

9. Use P to represent the number of people in the resort area during the summer. Then set up a proportion, making sure both ratios make the same comparison.



To solve this proportion, invert both ratios and then multiply by 3000. The number of people in the area during the summer is 24,000.

10. No matter how many servings you make, the ratio of cups of oatmeal to servings is $\frac{1}{3}$. To find the amount of oatmeal m needed for 2 servings, you can solve the proportion $\frac{1}{3} = \frac{m}{2}$. Multiplying by 2, you get $m = \frac{2}{3}$ cup. You need four times as much water as oatmeal, so you need $4 \cdot \frac{2}{3}$, or $\frac{8}{3}$, or $2\frac{2}{3}$ cups of water.

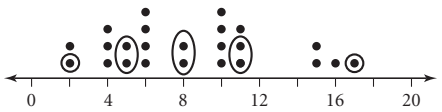
You can use the same strategy to find the amounts for 5 servings, or you can just add the amounts for 2 servings to the amounts for 3 servings. For 5 servings, you need $4 + 2\frac{2}{3} = 6\frac{2}{3}$ cups water and $1 + \frac{2}{3} = 1\frac{2}{3}$ cups oatmeal.

11. a. 3 carbon, 6 hydrogen, 1 oxygen

b. You will need 3(470), or 1410 atoms of carbon and 6(470), or 2820 atoms of hydrogen.

c. 500 molecules; use all the hydrogen atoms, 1500 carbon atoms, and 500 oxygen atoms.

12. Reading from the plot, the values are 2, 2, 4, 4, 4, 5, 5, 6, 6, 6, 6, 8, 8, 10, 10, 10, 10, 11, 11, 11, 15, 15, 16, 17. The median of these 24 values is 8, the mean of the twelfth and thirteenth values (8 and 8). Q1 is 5, the mean of the sixth and seventh values (5 and 5). Q2 is 11, the mean of the eighteenth and nineteenth values (11 and 11).



13. Mean: \$104.9 million; median: \$77.5 million; modes: \$210 million, \$80 million. The high incomes of Mel Gibson and Oprah Winfrey make the mean much higher than the median. The modes are meaningless for a data set this small.

14. a. $5 \cdot -4 + 8 = -20 + 8 = -12$

b. $-12 \div (7 - 4) = -12 \div 3 = -4$

c. $-3 - 6 \cdot 25 \div 30 = -3 - 150 \div 30 = -3 - 5 = -8$

d. $18\ (-3) \div 81 = -\frac{2}{3}$

LESSON 2.2

Exercises

1. Sample answers:

a. In this proportion, 24 is the part, w is the whole, and 32 is the percent. So the proportion represents this question: 32% of what number is 24?

b. In this proportion, t is the part, 450 is the whole, and 48 is the percent. So the proportion represents this question: 48% of 450 is what number?

c. In this proportion, 98 is the part, 117 is the whole, and n is the percent. So the proportion represents this question: What percent of 117 is 98?

2. Different variables will be used.

a. In general, a percent question can be expressed by a proportion in the form $\frac{\text{part}}{\text{whole}} = \frac{\text{percent}}{100}$. In this question, we are given the percent, 125, and the part, 80. If we let d represent the whole, we can write the proportion $\frac{80}{d} = \frac{125}{100}$.

b. In this question, we are given the percent, 0.25, and the whole, 46. If we let k represent the part, we can write the proportion $\frac{k}{46} = \frac{0.25}{100}$.

c. In this question, we are given the part, 72, and the whole, 470. If we let r represent the percent, we can write the proportion $\frac{72}{470} = \frac{r}{100}$.

3. The ratio of twelfth graders to all students is equal to 17% or $\frac{17}{100}$. To find the number of twelfth graders x, write and solve a proportion.

$$\frac{x}{1582} = \frac{17}{100}$$

$x = \frac{17}{100} \cdot 1582$ Multiply by 1582 to undo the division.

$x = 268.94$ Multiply and divide.

There are 269 twelfth graders.

4. a. The ratio of tagged fish in the sample to total fish in the sample is $\frac{5}{75}$. This is approximately equal to the ratio of tagged fish in the lake, 250, to total fish in the lake, f. So, to estimate the number of fish in the lake, solve the proportion $\frac{5}{75} = \frac{250}{f}$.

$$\frac{5}{75} = \frac{250}{f}$$

$\frac{75}{5} = \frac{f}{250}$ Invert both sides.

$250 \cdot \frac{75}{5} = f$ Multiply by 250 to undo the division.

$3750 = f$ Multiply and divide.

There are about 3750 fish in the lake.

b. The ratio of tagged fish in the sample to total fish in the sample should be about equal to $\frac{250}{5500}$ (the ratio of tagged fish in the lake to total fish in the lake). So, solve the proportion $\frac{250}{5500} = \frac{15}{f}$ to find the number of fish in the sample. There are about 330 fish in the sample.

5. a. Marie has won more than half of the games so far, so she should win more than 6 of the next 12 games.

b. $\frac{\text{28 games won by Maria}}{\text{28 + 19 total games}} = \frac{M}{12}$; $M = 7.15$. So Marie should win 7 games.

c. $\frac{19}{47} = \frac{30}{G}$ (Both ratios express the ratio of Tracy's wins to games played.); $G \approx 74$; they would need to play about 74 games.

6. a. Slightly fewer than 600 pieces. Sixteen ounces is almost ten times 1.69 ounces.

b. $\frac{\text{60 candy pieces}}{\text{1.69 oz}} = \frac{N \text{ pieces}}{\text{16 oz}}$; there are about 568 candies in a 1 lb bag.

c. $\frac{1{,}000{,}000}{568} \approx 1761$ lb

7. Let $E =$ the total number of errors in the paper.

$$\frac{\text{errors found by Terry}}{\text{total errors}} = \frac{\text{errors found by both}}{\text{errors found be Jesse}}$$

$$\frac{24}{E} = \frac{18}{36}$$

$$E = 48$$

This method gives an estimated total of 48 errors in the paper. Of these, 18 were found by both Terry and Jesse, $24 - 18 = 6$ were found only by Terry, and $36 - 18 = 18$ were found only by Jesse. Thus, the number of errors found by at least one of them was $6 + 18 + 18 = 42$. Therefore, the estimate of the number of errors both of them missed is $48 - 42 = 6$ errors.

8. Bass $= \frac{360}{24} \cdot 235 = 3525$. Trout $= \frac{223}{15} \cdot 147 = 2185.4$. Perch $= \frac{208}{16} \cdot 151 = 1963$. Total $= \frac{791}{55} \cdot 533 = 7665.5$. These values are estimates, so the total should be close to the sum of the species totals, but not exactly equal to it.

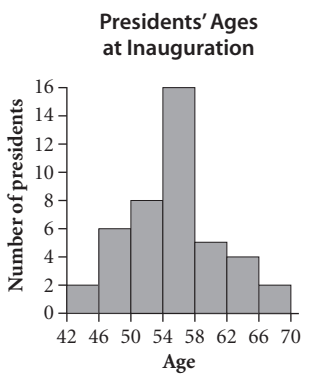
9. a. $\frac{5}{3}$ **b.** $\frac{5}{8}$ **c.** $\frac{3}{8}$

10. a. When the ages are ordered, the median is between the 21st and 22nd values. Looking at the bar heights, you can see that both values are in the bin 54–56. So, the median age is 54 or 55.

b. $2 + 3 + 3 = 8$

c. Younger than 42, 44, 45, 66, 67, older than 69.

d.



11. $12 - 2 \cdot 6 - 3 = 12 - 12 - 3 = 0 - 3 = -3$. Matt is correct. Marta and Miguel did not use the order of operations. Marta did the operations from left to right, and Miguel did the subtractions before he multiplied. In the order of operations, multiplication comes first.

LESSON 2.3

Exercises

1. a. $x = 49.4$ **b.** $x = 40$

c. $x \approx 216$ **d.** $x = 583.\overline{3}$

2. $\frac{\text{1 mi}}{\text{3 min 53.43 s}} = \frac{\text{1 mi}}{\text{(3 · 60 + 53.43) s}} = \frac{\text{5280 ft}}{\text{233.43 s}} \approx 22.62$ ft/s

3. a. $\frac{50 \cancel{\text{m}}}{1 \cancel{\text{s}}} \cdot \frac{1 \text{ km}}{1000 \cancel{\text{m}}} \cdot \frac{60 \cancel{\text{s}}}{1 \cancel{\text{min}}} \cdot \frac{60 \cancel{\text{min}}}{1 \text{ h}} = 180$ km/h

b. $0.025 \cancel{\text{day}} \cdot \frac{24 \cancel{\text{h}}}{1 \cancel{\text{day}}} \cdot \frac{60 \cancel{\text{min}}}{1 \cancel{\text{h}}} \cdot \frac{60 \text{ s}}{1 \cancel{\text{min}}} = 2160$ s

c. $1200 \cancel{\text{oz}} \cdot \frac{1 \cancel{\text{lb}}}{16 \cancel{\text{oz}}} \cdot \frac{1 \text{ ton}}{2000 \cancel{\text{lb}}} = 0.0375$ ton

4. In each part, the ratio of ounces to grams is equal to 1 to 28.4 (or, equivalently, the ratio of grams to ounces is 28.4 to 1).

a. $\frac{8 \text{ oz}}{x \text{ g}} = \frac{1 \text{ oz}}{28.4 \text{ g}}$; 227 g

b. $\frac{x \text{ oz}}{50 \text{ g}} = \frac{1 \text{ oz}}{28.4 \text{ g}}$; 1.76 oz

c. $\frac{160 \text{ oz}}{x \text{ g}} = \frac{1 \text{ oz}}{28.4 \text{ g}}$; 4544 g

d. $\frac{x \text{ oz}}{100 \text{ g}} = \frac{1 \text{ oz}}{28.4 \text{ g}}$; 3.52 oz

5. In each part, the ratio of centimeters to inches is equal to 2.54 to 1 (or, equivalently, the ratio of inches to centimeters is 1 to 2.54).

a. $\frac{x \text{ cm}}{62.5 \text{ in.}} = \frac{2.54 \text{ cm}}{1 \text{ in.}}$; about 159 cm

b. $\frac{x \text{ cm}}{96 \text{ in.}} = \frac{2.54 \text{ cm}}{1 \text{ in.}}$; about 244 cm

c. $\frac{12 \text{ cm}}{x \text{ in.}} = \frac{2.54 \text{ cm}}{1 \text{ in.}}$; about 4.72 in.

d. $\frac{3.25 \text{ cm}}{x \text{ in.}} = \frac{2.54 \text{ cm}}{1 \text{ in.}}$; about 1.28 in.

6. a. $\frac{3 \text{ pounds}}{30 \text{ days}} = 0.1$ pound per day

b. $\frac{5 \text{ pounds}}{45 \text{ days}} = 0.\overline{1}$ pound per day

c. Crystal's cat eats more each day.

7. a. Divide the first meter measurement in the table by the first yard measurement: $\frac{6.3 \text{ m}}{7 \text{ yd}} = \frac{0.9 \text{ m}}{1 \text{ yd}}$. Dividing each of the other meter measurements by the corresponding yard measurement and rounding to the nearest tenth gives 1 yd $\approx$ 0.9 m, so a conversion factor from yards to meters is 1 yd $\approx$ 0.9 m.

To find a conversion factor from meters to yards, divide the yard measurements by the meter measurements. For example, $\frac{7\text{ yd}}{6.3\text{m}} \approx \frac{1.1\text{ yd}}{1\text{ m}}$. Thus, a conversion factor from meters to yards is 1 m ≈ 1.1 yd.

b. Solve this proportion $\frac{0.9\text{ m}}{1\text{ yd}} = \frac{x\text{ m}}{100\text{ yd}}$. A football field is about 90 meters long.

c. Solve this proportion $\frac{0.9\text{ m}}{1\text{ yd}} = \frac{200\text{ m}}{x\text{ yd}}$. The exit is about 222 yards away.

d. Solve this proportion $\frac{0.9\text{ m}}{1\text{ yd}} = \frac{100\text{ m}}{x\text{ yd}}$, or just find half of the answer to 7c. A 100-meter dash is about 111 yards long.

e. Solve this proportion: $\frac{0.9\text{ m}}{1\text{ yd}} = \frac{x\text{ m}}{15\text{ yd}}$. You should buy 13.5 meters of fabric if you need 15 yards.

8. a.

Yards	1	2	3	4	5
Feet	3	6	9	12	15

b. 3

c. Because there are 3 feet in every yard, the ratio of feet f to yards y is 3 to 1. You can write this as the proportion $\frac{f}{y} = \frac{3}{1}$.

d. i. 450 ft **ii.** 128 yd

9. $1500\ \cancel{\text{m}} \cdot \frac{1\ \cancel{\text{km}}}{1000\ \cancel{\text{m}}} \cdot \frac{1\text{ mi}}{1.6\ \cancel{\text{km}}} = 0.9375\text{ mi}$

Because 1500 meters is less than a mile, the 1-mile race is longer.

10. a. To make 120 servings, you need 120 · 8, or 960 oz of lemonade. One can of concentrate makes 64 oz, so to make 960 oz, you need 960 ÷ 64, or 15 cans of concentrate. Using dimensional analysis:

$120\ \cancel{\text{servings}} \cdot \frac{8\ \cancel{\text{oz}}}{1\ \cancel{\text{serving}}} \cdot \frac{1\text{ can}}{64\ \cancel{\text{oz}}} = 15\text{ cans}$

b. Because 12 oz of concentrate makes 64 oz of lemonade, you need $\frac{12}{64}$, or 0.1875 oz to make 1 oz of lemonade.

c. $\frac{\text{number of oz of concentrate}}{\text{number of oz of lemonade}} = \frac{12}{64}$

d. $\frac{16}{L} = \frac{12}{64}$; $L \approx 85$ oz

11. $120\ \cancel{\text{mL}} \cdot \frac{1\ \cancel{\text{L}}}{1000\ \cancel{\text{mL}}} \cdot \frac{1.06\ \cancel{\text{qt}}}{1\ \cancel{\text{L}}} \cdot \frac{4\text{ cups}}{1\ \cancel{\text{qt}}} = 0.5088\text{ cup}$, or about $\frac{1}{2}$ cup

12. The Math Club has $\frac{3}{5}$ of the 20 students. If the profits are divided in proportion to the number of students in the clubs, the Math Club would get $\frac{3}{5} \cdot 480$, or \$288, leaving \$480 − \$288, or \$192 for the Chess Club.

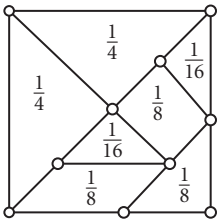
13. Because only five values are represented in the plot, they must correspond to the values in the five-number summary: 10 cm, 22 cm, 33 cm, 41 cm, 46 cm.

From the first bullet, you know that the pygmy kingfisher has length 10 cm and the laughing kookaburra has length 46 cm.

The mean length of the five birds is 30.4. So, the second bullet indicates that the belted kingfisher is 30.4 + 2.6, or 33 cm long. This leaves 22 cm and 41 cm.

Because the ringed kingfisher's length is closer to the median than the green kingfisher, the ringed kingfisher has length 41 cm, and the green kingfisher has length 22 cm.

Improving Your Visual Thinking Skills



LESSON 2.4

Exercises

1. a. 40; find the y-value corresponding to an x-value of 25.

b. 75; find the x-value corresponding to a y-value of 120.

2. a. 88; scroll down to find the y-value corresponding to the x-value 55.

b. 281; scroll down to find the x-value corresponding to a y-value of about 450.

3. To change miles to kilometers, multiply by 1.6; to change kilometers to miles, divide by 1.6.

Distance (mi)	Distance (km)
2.8	4.5
7.8	**12.5**
650.0	**1040.0**
937.5	1500.0

4. a. Divide by 3.5 to undo the multiplication; $x = 4$.

b. Divide by 8 to undo the multiplication; $x = 3.4875$.

c. Multiply by 7 to undo the division; $x = 2.625$.

d. Change the proportion to $\frac{x}{12} = \frac{1}{0.8}$. Then multiply by 12 to undo the division; $x = 15$.

5. a. $c = 1.25(2.5) = 3.125$, or \$3.13

b. Substitute 5 for c to get $5 = 1.25f$. Then solve for f.

$$5 = 1.25f$$
$$\frac{5}{1.25} = \frac{1.25f}{1.25}$$
$$4 = f$$

You can buy 4 yd of fabric for \$5.

c. \$1.25

6. a.

Market A

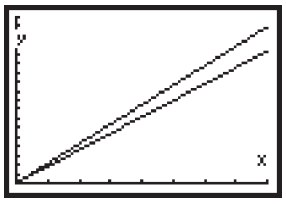
Ears	7	14	21	28	35	42
Cost (\$)	1.25	2.50	3.75	5.00	6.25	7.50

Market B

Ears	13	26	39	52	65	78
Cost (\$)	2.75	5.50	8.25	11.00	13.75	16.50

b. For Market A, the cost per ear is \$1.25 ÷ 7, or about \$0.179. So, if x is the number of ears and y is the total cost in dollars, then $y = 0.179x$.

For Market B, the cost per ear is \$2.75 ÷ 13, or about \$0.212. So, if x is the number of ears and y is the total cost in dollars, then $y = 0.212x$.



[0, 80, 10, 0, 18, 1]

c. Market A: \$0.18; Market B: \$0.21; these are the constants of variation in the equations, rounded to the nearest hundredth.

d. The graph for the market with the lower rate (Market A) is less steep than the graph for the market with the higher rate.

7. a.

Vegetable	Weight (kg)	Weight (lb)
Cabbage	56	123
Summer squash	49	108
Zucchini	29	64
Kohlrabi	28	62
Celery	21	46
Radish	13	28
Cucumber	9	20
Brussels sprout	8	18
Carrot	5	11

b. Divide each pound value by the corresponding kilogram value and find the mean or median of the values. You should find that there are about 2.2 pounds per kilogram. So, if x is the number of kilograms and y is the number of pounds, then $y = 2.2x$.

c. Solve $6.5 = 2.2x$. The pumpkin weighs about 2.95 kg.

d. $y = 2.2 \cdot 3600 = 7920$. The elephant weighs 7920 lb.

e. 100 lb = $45.\overline{45}$ kg; 100 kg = 220 lb

8. a. Thu calculated $\frac{150}{93} \approx 1.61$, which is the number of kilometers per mile. In Thu's equation, x is the number of miles and y is the number of kilometers.

b. Sabrina calculated $\frac{93}{150} = 0.62$, which is the number of miles per kilometer. In Sabrina's equation, x is the number of kilometers and y is the number of miles.

c. Thu's equation may be more convenient because you can just multiply the number of miles by 1.61.

d. Sabrina's equation is more convenient for converting kilometers to miles.

9. a. Answers will vary. A sample answer is to use the value of U.S. coins and bills in dollar denominations: {100, 50, 20, 10, 5, 1, 0.50, 0.25, 0.10, 0.05, 0.01}.

b. Multiply the list by the exchange rate. For example, to convert to Japanese yen, multiply the list by 104.160. The result would be {10416, 5208, 2083.2, 1041.6, 520.8, 104.16, 52.08, 26.04, 10.416, 5.208, 1.0416}.

c. Divide list L_2 by the exchange rate to obtain the original values.

d. Using dimensional analysis:

$$\frac{11.297 \text{ pesos}}{1 \text{ dollar}} \cdot \frac{1 \text{ dollar}}{0.772 \text{ euros}}$$
$$\approx 14.633 \text{ pesos per euro}$$

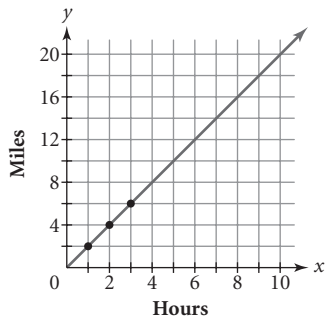
Then multiply the number of euros by this exchange rate.

10. a. Because distance and time are directly proportional, the ratio of distance to time is a constant. I walk 3 mi in 1.5 h, so the constant ratio is $\frac{3 \text{ mi}}{1.5 \text{ h}}$, or 2 mi/h. So in 1 h I can walk 2 mi.

b. 2 h · 2 mi/h = 4 mi

c. It takes 1 h to walk 2 mi, so it would take 3 h to walk 6 mi.

d.



e. The constant of variation, 2 mi/h, represents the constant walking speed.

f. $d = 2t$, where d is distance traveled in miles and t is travel time in hours

11. a. $D = 5t$, where D is the distance traveled, in inches, and t is the time elapsed, in minutes.

b. The constant of variation is 5. This is the constant rate of 5 in. every min.

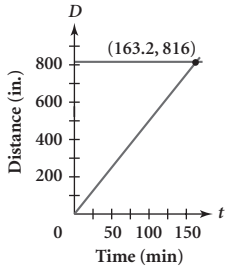
c. The distance traveled in 1 h (or 60 min) is $5(60) = 300$ in.

d. The perimeter of the room is $2(14 \text{ ft}) + 2(20 \text{ ft}) = 68$ ft. Convert this distance to inches: $68 \text{ ft} \cdot \frac{12 \text{ in}}{1 \text{ ft}} = 816$ in. Substitute 816 for D in the equation $D = 5t$ and solve for t.

$$D = 5t$$
$$816 = 5t$$
$$t = \frac{816}{5} = 163.2$$

It would take the bug 163.2 min, or 2.72 h, to completely "circle" the room.

e.



12. a. $\frac{130 \text{ km}}{1 \text{ h}} \cdot \frac{1 \text{ mi}}{1.6 \text{ km}} = 81.25$ mi/h

b. $\frac{25 \text{ mi}}{1 \text{ h}} \cdot \frac{1.6 \text{ km}}{1 \text{ mi}} = 40$ km/h

c. 65 miles per hour is 104 kilometers per hour. A speed limit sign might post 100 kilometers per hour.

13. a. To make \$12 per hour, she would need to earn \$36 for a 3-hour party. \$36 ÷ \$3.50 is about 10.3, so she would have to entertain a minimum of 11 children.

b. Solve $\frac{0.6}{3.50} = \frac{p}{100}$; $p \approx 17$, so the cost of balloons and face paint per child is about 17% of the total cost per child.

c. Solve $\frac{0.6}{x} = \frac{10}{100}$; $x = 6$, so Cecile should charge \$6 per child.

14. a. \$2.49 per box, 42¢ per bar, \$2.99 per box, 25¢ per ounce

b. Yes; \$2.49 ÷ 6 = \$0.415, so the bars cost 42¢ each.

c. $\frac{2.99 \text{ dollars}}{1 \text{ box}} \cdot \frac{1 \text{ box}}{8 \text{ bars}} \cdot \frac{1 \text{ oz}}{0.25 \text{ dollar}} = \frac{2.99 \text{ oz}}{2 \text{ bars}} = 1.495$ oz per bar

d. $\frac{\$2.49}{10 \text{ oz}} = \$0.249$ per oz or approximately 25¢ per oz

e. Possible answer: Both brands cost the same amount per oz. Chewy Granola Bars cost less per bar (37¢ versus 42¢), but the bars are smaller. If Marie and Tracy prefer fewer, larger bars, they should buy Crunchy Granola Bars. If they prefer more, smaller bars, they should buy Chewy Granola Bars.

LESSON 2.5

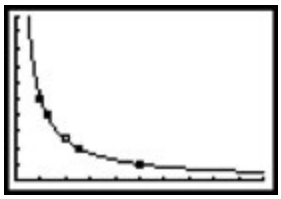
EXERCISES

1. a. $y = \frac{15}{x}$ **b.** $y = \frac{35}{x}$ **c.** $y = \frac{3}{x}$

2. Because x and y are inversely proportional, their product is constant. When $x = 3$, $y = 4$, so the constant product is $3 \cdot 4$, or 12. In 2a–d, you need to find the value such that the coordinates have a product of 12.

a. 3 **b.** 6 **c.** 12 **d.** 0.5

3. Answers will vary. For each point, the product of the coordinates must be 20. Possible points include (4, 5), (2, 10), (5, 4), (10, 2), and (2.5, 8). Here is a graph of the points and the equation made using the window [0, 20, 2, 0, 20, 2].



[0, 20, 2, 0, 20, 2]

4. This is not an inverse variation. The product of the quantities *time spent watching TV* and *time spent doing homework* is not a constant. It is an inverse relationship only in the sense that as one increases the other decreases, but the sum, not the product, is a constant. This is a relationship of the form $x + y = k$ or $y = k - x$, not an inverse variation of the form $xy = k$ or $y = \frac{k}{x}$.

5. a. 3 h **b.** 2 h **c.** 60 mi/h

6. a. Inverse variation; the x- and y-values have a constant product, 24; the equation is $y = \frac{24}{x}$, or $xy = 24$.

b. Direct variation; the ratio of y to x is constant; the equation is $y = 12x$.

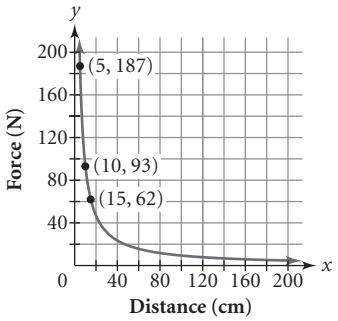
c. Neither; it is not an inverse variation because some of the values are 0, and neither variable in an inverse variation can have the value 0; it is not a direct variation because the ratio of y to x is not constant $\left(\text{for example, } \frac{3.0}{3.0} = 1, \text{ while } \frac{1.5}{6} = 0.25\right)$.

d. Inverse variation; the x- and y-values have a constant product, 19.5; the equation is $y = \frac{19.5}{x}$, or $xy = 19.5$.

7. a. If x is the distance and y is the force, then $y = \frac{935}{x}$. Substitute each given distance for x to find the corresponding force: $62.\overline{3}$ N, 93.5 N, and 187 N.

b. As you move closer to the hinge, it takes more force to open the door. When you go from 15 cm to 10 cm, the required force increases by about 31.2 N. When you go from 10 cm to 5 cm, the required force increases by 93.5 N. As you move closer, the force needed increases more rapidly. When you get very close to the hinge, the force needed becomes extremely large.

c. The curve goes up very steeply near the y-axis.



8. a. *Sid's weight* · *Sid's distance* = *Emily's weight* · *Emily's distance*, so $65 \cdot 4 =$ *Emily's weight* $\cdot$ 2.5; Emily weighs 104 lb.

b. Solve the equation $130 \cdot 4 = 104 \cdot D$ to find the distance Emily would have to sit from the center if the boys sit on the seat. Emily would have to sit 5 ft from the center. The distance from the center to the seat is only 4 ft, so she can't balance the two boys as long as they stay on the seat. However, if the boys move and Emily sits on the seat, it can be done. Solve $130 \cdot D = 104 \cdot 4$ to find the distance the boys would then have to sit from the center. They must sit 3.2 ft from the center.

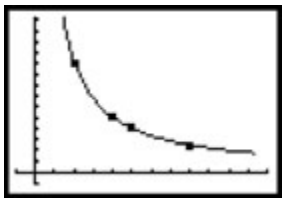
9. a. If the balance point is at the center, then the weight of an unknown object will be exactly the same as the weight that balances it on the other side. If the balance point is off-center, you must know the two distances and do some calculation.

b. $15 \cdot M = 20 \cdot 7$; $M \approx 9.3$ kg

10. a. Answers will vary. In every case, the number of students times the amount should equal \$10,000.

Number of students	Amount each needs to raise
100	\$100
200	\$50
250	\$40
400	\$25

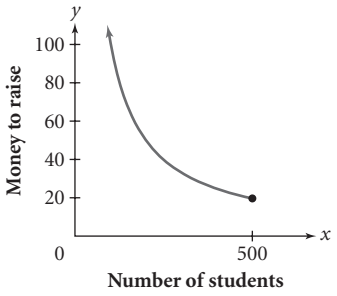
b.



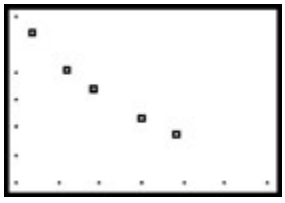
[−50, 600, 50, −10, 140, 10]

$y = \frac{10{,}000}{x}$

c. The graph should stop at $x = 500$ because there are only 500 students.



11. a. Answers will vary. On this graph, x represents frequency and y represents tube length. As the frequency increases, the tube length decreases; this appears to be an inverse relationship.



[400, 1000, 100, 30, 90, 10]

b. Possible answer: $y = \frac{37{,}227.1}{x}$, where 37,227.1 is the mean of the products of the frequencies and tube lengths.

c. $y = \frac{37{,}227.1}{880.0}$; $y \approx 42.3$ cm

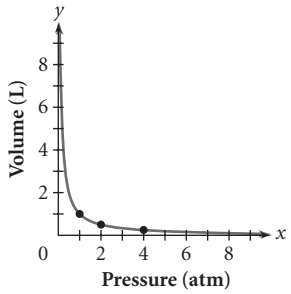
12. a. The product of the volume and the pressure is a constant. When the pressure is 1 atm, the volume is 1 L, so the constant is $1 \cdot 1$, or 1. If the volume is 0.5 L, the pressure must be 2 atm.

b. $0.25p = 1$; pressure is 4 atm.

c. $v \cdot 10 = 1$; volume is 0.1 L.

d. Answers will vary. You would have to increase the volume of the container. If you kept the same volume, you would have to suck some of the air out of the container.

e.



13. $s = 0.85p$; $s = 0.85(\$13.95)$; the sale price is \$11.86.

14. a. Solve $\frac{5}{3} = \frac{2.5}{x}$; Mario's body should contain 1.5 lb of phosphorus.

b. 2% of 130 lb is 2.6 lb, so Kyla's body should contain 2.6 lb of calcium. To find the amount of phosphorus, solve the proportion $\frac{5}{3} = \frac{2.6}{x}$; Kyla's body should contain 1.56 lb of phosphorus.

15. a. $\frac{1 \text{ apartment}}{3 \text{ gal}} \cdot 36 \text{ gal} = 12 \text{ apartments}$

b. $\frac{3 \text{ gal}}{\text{apartment}} \cdot 24 \text{ apartments} = 72 \text{ gal}$

16. a. 1 sulfur atom, 2 hydrogen atoms, and 4 oxygen atoms

b. There is 1 sulfur atom for every 2 hydrogen atoms, so it would take 100 sulfur atoms to combine with 200 hydrogen atoms. There are 4 oxygen atoms for every 2 hydrogen atoms. So, it would take 400 oxygen atoms to combine with 200 hydrogen atoms.

c. Use all 400 atoms of oxygen, 200 atoms of hydrogen, and 100 atoms of sulfur to make 100 molecules of sulfuric acid.

LESSON 2.6

Activity day: There are no answers for this lesson.

LESSON 2.7

Exercises

1. a.

■	■	1 1	0	6	2	2 1	8	■
■	■	5	■	■	■	7	■	■
■	■	5	■	■	■	3 3	6	■
4 5	5	7	5 8	■	■	7	■	■
6	■	■	6 1	4	3	/	4	2
7 7	9	8 4	9	■	■	4	■	■
■	■	3	■	■	9 1	0	■	■
■	■	3	■	10 4	■	■	■	■
11	1	4	8	0	■	■	■	■
3	■	9	■	·	■	■	■	■
1	■	■	■	5	■	■	■	■
0	■	■	■	2	■	■	■	■
12 1	8	5	1	9	3	■	■	■

Across:

1. (2/3)(159327) = 106218

3. (−1 + 17^2)/(4 + 2^2) = 36

4. 4835 − 541 + 1284 = 5578

6. (3 + 140)/(3*14) ▶ Frac = 143/42

7. 8075 − 3*42 = 7949

9. √(6^2 + 8^2) = 10

11. 740/(18.4 − 2.1*9) = −1480

12. 57^3 = 185193

Down:

1. 9(−7 + 180) = 1557

2. (9/2)(17/5 + 25/4) ▶ Frac = 1737/40

4. 3 − 3(12 − 200) = 567

5. 9*10^2 − 9^2 = 819

8. 15 + 47(922) = 43349

10. 25.9058*20/4 − 89 = 40.529

11. 1284 − 877/0.2 = −3101

2. Seija. Peter incorrectly added before multiplying.

3. a. First multiply 16 by 4.5. Then add 9.

b. First divide 18 by 3. Then add 15.

c. First square 6. Then add −5. Then multiply by 4. Then subtract the result from 3.

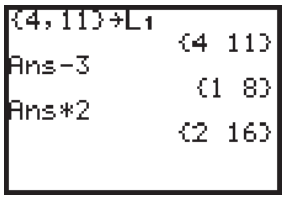
4.

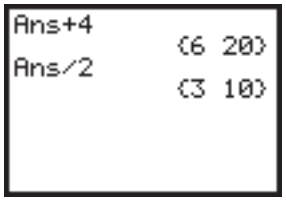
Description	Claudia's sequence	Al's sequence
Pick the starting number.	-8.6	x
Add 5.	-3.6	$x + 5$
Multiply by 4.	-14.4	$4(x + 5)$
Subtract 12.	-26.4	$4(x + 5) - 12$
Divide by 4.	-6.6	$\frac{4(x + 5) - 12}{4}$
Subtract the original number.	2	$\frac{4(x + 5) - 12}{4} - x$

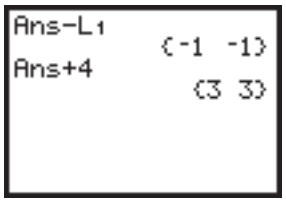
5. a. 1. Pick a number.
2. Subtract 3.
3. Multiply your result by 2.
4. Add 4.
5. Divide by 2.
7. Add 4 or multiply by -3.

b. Stages 6 and 7; the original number has been subtracted.

c. Sample answer for the list {4, 11}:







d. $\frac{2(n - 3) + 4}{2} - n + 4$ or $-3\left[\frac{2(n - 3) + 4}{2} - n\right]$

6. a. Number Trick 1: Pick the starting number. Multiply by 2. Multiply by 3. Add 6. Divide by 3. Subtract your original number. Subtract your original number again.

b. Number Trick 2: Pick the starting number. Add 2. Multiply by 3. Add 9. Subtract 15. Multiply by 2. Divide by 6 (you should have your original number).

7. a. Possible answers:

$(3 + 2)(5) - 7 = 18$. First add 3 and 2 to get 5. Then multiply by 5 to get 25. Then subtract 7 to get 18.

$3(2) + 5 + 7 = 18$. Multiply 3 by 2 to get 6. Then add 5 to get 11. Then add 7 to get 18.

b. $8 - 5(6 - 7) = 13$. First subtract 7 from 6 to get -1. Then multiply by 5 to get -5. Then subtract this result from 8 to get 13.

8. a. Pick a number. Subtract 5. Multiply by 4. Add 8. Divide by 2. Subtract the original number. Add 6.

b. Solutions will vary. The trick always produces the original number.

9. Possible solutions:

$1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 \cdot 9 = 100$;

$-1 + 2 + 3 + 4 \cdot 5 \cdot 6 - 7 - 8 - 9 = 100$;

$12 + 34 + 5 \cdot 6 + 7 + 8 + 9 = 100$

10. Answers will vary. Sample answer:

a. Pick a number. Subtract 3. Multiply by 2. Add 10. Divide by 2. Subtract the original number. Subtract 6.

b. I started with x and started applying operations. I subtracted 3, then multiplied by 2, and then subtracted 10. Because I multiplied by 2, I knew I had to undo this by dividing by 2, so I added this step. Then I subtracted the original number so that the final result would not be affected by the starting number chosen. I tested my trick, and I always ended up with 2. I added the step "Subtract 6" so that everyone would get -4.

c. $\frac{2(x - 3) + 10}{2} - x - 6$

11. a. $\frac{308 \text{ mi}}{10.8 \text{ gal}} \approx 28.5$ mpg

b. $\frac{1 \text{ gal}}{28.5 \text{ mi}} \cdot 750 \text{ mi} \approx 26.3$ gal

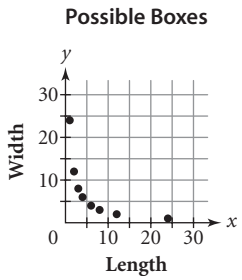
c. $26.3 \text{ gal} \cdot \frac{\$2.35}{1 \text{ gal}} \approx \$61.81$

d. Portia's gas mileage is more than 19%, or 6.5 mpg lower than the higher estimate. It is about 5%, or 1.5 mpg lower than the lower estimate.

12. a.

Length (in.)	Width (in.)
1	24
2	12
3	8
4	6
6	4
8	3
12	2
24	1

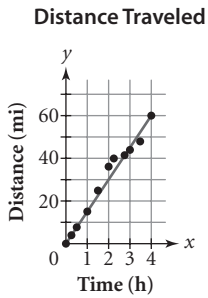
b.



c. Inverse variation; the product of the length and the width equals a constant.

d. $l \cdot w = 24$, or $w = \frac{24}{l}$. Yes, the situation requires the dimensions to be whole numbers of inches.

13. a. Here is the scatter plot (the line is added in 13c):



b. The cyclist traveled 60 miles in 4 hours, so the average speed was 60 ÷ 4 or 15 mi/h.

c. $y = 15x$, where x is the time in hours and y is the distance in miles

d. From 1 h to 2.25 h and from 3.5 h to 4 h, the cyclist's speed is greater than the average speed, indicating that he or she may be traveling downhill. From 2.25 h to 3.5 h, the cyclist's speed is less than the average speed, indicating that he or she may be traveling uphill.

Improving Your Reasoning Skills

Encourage students to check their expressions for unnecessary parentheses. For example, 5 • (3^2) can be written more simply as 5 • 3^2.

a. 5 • (13 − 4)

b. 5 • 3^2

c. 5 • 13 + 5 • −4

d. (100 + 35)/(1 + 2)

e. (6 + 3) • 5

f. 5 + 5 • 8

g. 5 • (1 + 8)

h. 5 • 3^(1 + 1)

i. 65 − 5 • (3 + 1)

j. 87 − 6 • (10 − 3)

k. −3^2 + 54

LESSON 2.8

Exercises

1. a. $-4 + (-8) = -12$

b. $(-4)(-8) = 32$

c. $-2(3 + 9) = -2(12) = -24$

d. $5 + (-6)(-5) = 5 + 30 = 35$

e. $(-3)(-5) + (-2) = 15 + (-2) = 13$

f. $\frac{-15}{3} + 8 = -5 + 8 = 3$

g. $\frac{23 - 3(4 - 9)}{-2} = \frac{23 - 3(-5)}{-2} = \frac{23 + 15}{-2}$
$= \frac{38}{-2} = -19$

h. $\frac{-4[7 + (-8)]}{8} - 6.5 = \frac{-4(-1)}{8} - 6.5$
$= \frac{4}{8} - 6.5 = 0.5 - 6.5 = -6$

i. $\frac{6(2 \cdot 4 - 5) - 2}{-4} = \frac{6(8 - 5) - 2}{-4}$
$= \frac{6(3) - 2}{-4} = \frac{18 - 2}{-4} = \frac{16}{-4} = -4$

2. a. Subtract 32.

b. Divide by 9.

c. Multiply by 9.

d. Add 32.

3. a. $2(6) + 3 = 12 + 3 = 15$

b. $2(6 + 3) = 2(9) = 18$

c. $5(6) - 13 = 30 - 13 = 17$

d. $\frac{6 + 9}{3} = \frac{15}{3} = 5$

4. a. $x = 15$. Order of operations: Start with x. Subtract 3. Divide by 2. The result is 6. Working backward: Start with 6. Multiply by 2. Add 3. The result is 15.

Equation: $\frac{x - 3}{2} = 6$

Operations on x	Undo operations	Results
		$x = 15$
− (3)	+ (3)	12
/ (2)	• (2)	6

b. $x = 5$. Order of operations: Start with x. Multiply by 3. Add 7. The result is 22. Working backward: Start with 22. Subtract 7. Divide by 3. The result is 5.

Equation: $3x + 7 = 22$

Operations on x	Undo operations	Results
		$x = 5$
• (3)	/ (3)	15
+ (7)	− (7)	22

c. $x = 6$. Order of operations. Start with x. Divide by 6. Subtract 20. The result is -19. Working backward: Start with -19. Add 20. Multiply by 6. The result is 6.

Equation: $\frac{x}{6} - 20 = -19$

Operations on x	Undo operations	Results
/ (6)	· (6)	$x = 6$
		1
− (20)	+ (20)	−19

5. Multiply by 60, multiply by 60 again, and then divide by 5280.

6. Justine could start with 33 and work backward, undoing each operation: Start with 33. Add 2 to get 35. Divide by 5 to get 7. Quentin picked 7.

7. a. 3

b. Start with 3 and see whether you get the answer 3.

c. 15

d. The final result is always the original number.

8. a. 8.8 **b.** 15

c. I undid the operations shown in reverse order: I multiplied by 5, then added 12, then divided by 2, and then subtracted 10.

d. $\frac{2(x + 10) - 12}{5}$

e. $\frac{2(x + 10) - 12}{5} = 0$. To solve this equation, work backward: Multiply by 5 to get 0. Add 12 to get 12. Divide by 2 to get 6. Subtract 10 to get -4. To check, use -4 as a starting number and work forward: Add 10 to get 6. Multiply by 2 to get 12. Subtract 12 to get 0. Divide by 5 to get 0.

9. a. 25. Add 7. Multiply by 5. Divide by 3.

b. Start with -18. Multiply by 3 to get -54. Divide by 5 to get -10.8. Subtract 7 to get -17.8.

10. a. $3(x - 5) + 8 = -14.8$

Equation: $3(x - 5) + 8 = -14.8$		
Description	**Undo**	**Result**
Pick x.		−2.6
− (5)	+ (5)	−7.6
· (3)	/ (3)	−22.8
+ (8)	− (8)	−14.8

$x = -2.6$

b. $3.5\left(\frac{x - 8}{4}\right) = 2.8$

Equation: $3.5\left(\frac{x - 8}{4}\right) = 2.8$		
Description	**Undo**	**Result**
Pick x.		11.2
− (8)	+ (8)	3.2
/ (4)	· (4)	0.8
· (3.5)	/ (3.5)	2.8

$x = 11.2$

c. $\frac{4(x - 5) - 8}{-3} = 12$

Equation: $\frac{4(x - 5) - 8}{-3} = 12$		
Description	**Undo**	**Result**
Pick x.		−2
− (5)	+ (5)	−7
· (4)	/ (4)	−28
− (8)	+ (8)	−36
/ (−3)	· (−3)	12

$x = -2$

d. $\frac{4 - 3(7 + 2x)}{5} + 18.5 = -74.9$

Equation: $\frac{4 - 3(7 + 2x)}{5} + 18.5 = -74.9$		
Description	**Undo**	**Result**
Pick x.		75
· (2)	/ (2)	150
+ (7)	− (7)	157
· (−3)	/ (−3)	−471
+ (4)	− (4)	−467
/ (5)	· (5)	−93.4
+ (18.5)	− (18.5)	−74.9

$x = 75$

11. a. $x = -2.4$. Start with 8. Subtract 4.2 to get 3.8. Multiply by 2.5 to get 9.5. Divide by 5 to get 1.9. Subtract 4.3 to get -2.4.

b. $x = 23.6$. Start with 5.4. Add 4.3 to get 9.7. Multiply by 5 to get 48.5. Divide by 2.5 to get 19.4. Add 4.2 to get 23.6.

12. $D = 6 + 0.4(t - 5)$

a. Substitute 60 for t in the equation and solve for D.

$D = 6 + 0.4(60 - 5) = 6 + 0.4(55) = 6 + 22 = 28$

After 60 min, the depth of the water is 28 in.

b. Substitute 36 for D in the equation and solve for t.

$36 = 6 + 0.4(t - 5)$

Undo adding 6 by subtracting 6.

$30 = 0.4(t - 5)$

Undo multiplying by 0.4 by dividing by 0.4.

$75 = t - 5$

Undo subtracting 5 by adding 5.

$80 = t$ or $t = 80$

It takes 80 min until the water is 36 in. deep.

c. $D = 6 + 0.4(t - 5)$

First, undo adding 6 by subtracting 6.

$D - 6 = 0.4(t - 5)$

Next, undo multiplying by 0.4 by dividing by 0.4.

$\frac{D - 6}{0.4} = t - 5$

Finally, undo subtracting 5 by adding 5.

$\frac{D - 6}{0.4} + 5 = t$ or $t = \frac{D - 6}{0.4} + 5$

13.

Equation: $\frac{3(2 - 4x)}{4} - 7 = 14$		
Description	**Undo**	**Result**
Pick x.		~~52~~ 6.5
$\cdot\ (-4)$	$/\ (-4)$ ~~$\cdot\ (-4)$~~	~~-13~~ 26
~~$-(2)$~~ $+\ (2)$	$-\ (2)$ ~~$+\ (2)$~~	~~27~~ 28
~~$+(3)$~~ $\cdot\ (3)$	$/\ (3)$ ~~$-(3)$~~	~~81~~ 84
$/\ (4)$	$\cdot\ (4)$	21
$-\ (7)$	$+\ (7)$	14

14. **a.** To find the speed in miles per hour, solve the proportion $\frac{x}{200} = \frac{1}{87}$. The car travels about 2.3 miles per hour. To convert this speed to feet per second, you can use dimensional analysis:

$$\frac{2.3\ \cancel{\text{mi}}}{1\ \cancel{\text{h}}} \cdot \frac{1\ \cancel{\text{h}}}{60\ \text{min}} \cdot \frac{5280\ \text{ft}}{1\ \cancel{\text{mi}}} \approx 202\ \text{ft/min}$$

b. To convert to centimeters per second, use dimensional analysis:

$$\frac{202\ \cancel{\text{ft}}}{1\ \cancel{\text{min}}} \cdot \frac{12\ \cancel{\text{in.}}}{1\ \cancel{\text{ft}}} \cdot \frac{2.54\ \text{cm}}{1\ \cancel{\text{in.}}} \cdot \frac{1\ \cancel{\text{min}}}{60\ \text{s}} \approx 103\ \text{cm/s}$$

15. **a.** $\frac{12.5\ \text{gal}}{350\ \text{mi}} \approx 0.036\ \text{gal/mi}$;

$\frac{0.036\ \text{gal}}{1\ \text{mi}} \cdot 520\ \text{mi} \approx 19\ \text{gal}$

b. $\frac{225\ \text{mi}}{10.7\ \text{gal}} \approx 21\ \text{mpg}$;

$\frac{21\ \text{mi}}{1\ \text{gal}} \cdot 9\ \text{gal} = 189\ \text{mi}$

16. **a.** $\frac{3}{4} + \frac{2}{3} + \frac{1}{2} = \frac{23}{12}$, or $1\frac{11}{12}$ cups

b. $\frac{3}{4}(\$6.98) + \frac{2}{3}(\$7.98) + \frac{1}{2}(\$4.98) = \$13.05$

Improving Your Reasoning Skills

This problem can be solved in several ways. By working backwards, you will realize that some numbers won't work. For example, for each child and the dog to get one cookie at the end, there must have been 7 cookies when the last child gives one to the dog and takes one-third. But 7 is not two-thirds of any number, so each child must have gotten at least 2 in the end, and so on up to 7, the smallest number that works. Another approach is to create a function and put it into a graphing calculator. At the last split, the number of cookies each child will receive can be given by the formula $y = \frac{1}{3}\left(\frac{2}{3}\left(\frac{2}{3}\left(\frac{2}{3}(x - 1) - 1\right) - 1\right) - 1\right)$. Looking at the table for this equation, you see that 79 is the first value of x that gives an integral value for y (when $x = 79$, $y = 7$).

CHAPTER 2 Review

Exercises

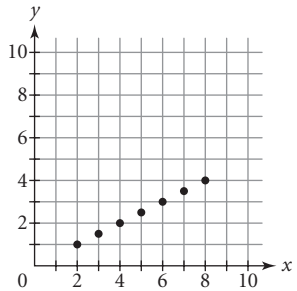
1. **a.** $n = 8.75$

b. $w = 84.6$

c. $k = 5\frac{1}{6}$, or $5.1\overline{6}$

2. Possible answers:
$\frac{7\ \text{bh}}{5\ \text{h}} = \frac{30\ \text{bh}}{x\ \text{h}}$; $\frac{7\ \text{bh}}{30\ \text{bh}} = \frac{5\ \text{h}}{x\ \text{h}}$; $\frac{5\ \text{h}}{7\ \text{bh}} = \frac{x\ \text{h}}{30\ \text{bh}}$;
$\frac{30\ \text{bh}}{7\ \text{bh}} = \frac{x\ \text{h}}{5\ \text{h}}$

3. **a.** Possible points include (2, 1), (3, 1.5), (4, 2), (5, 2.5), (6, 3), (7, 3.5), (8, 4).



b. All points appear to lie on a line.

4. **a.** $20\ \cancel{\text{ells}} \cdot \frac{3.75\ \text{ft}}{1\ \cancel{\text{ell}}} = 75\ \text{ft}$

b. $\frac{75\ \text{ft}}{12\ \cancel{\text{yr}}} \cdot \frac{1\ \cancel{\text{yr}}}{12\ \text{mo}} \approx \frac{0.52\ \text{ft}}{1\ \text{mo}} = 0.52\ \text{ft/mo}$

5. $\frac{\text{number of shih of millett}}{\text{total number of shih}}$ should be about equal to $\frac{\text{grains of millet in sample}}{\text{total grains in sample}}$. So, you can find the amount of millet m by solving this proportion $\frac{m}{1534} = \frac{28}{254}$. You have about 169 shih of millet and about $1534 - 169$, or 1365 shih of rice.

6. a. If x represents the weight in kilograms and y represents the weight in pounds, one equation is $y = 2.2x$, where 2.2 is the data set's mean ratio of pounds to kilograms.

b. Solve the equation $30 = 2.2x$. There are about 13.6 kg in 30 lb.

c. $y = 2.2(25) = 55$. There are 55 lb in 25 kg.

7. a. About 7.5 cm

b. The plant is growing about 1.5 cm per day. To reach a height of 25 cm will take $25 \div 1.5$, or about 17 days.

c. $H = 1.5 \cdot D$

8. a. Because the product of the x- and y-values is roughly constant, it is an inverse variation.

b. One possibility: $y = \frac{45.5}{x}$, where 45.5 is the mean of the products

c. $y = \frac{45.5}{32}$; $y \approx 1.4$

9. a. Directly: $d = 50t$

b. Directly: $d = 1v$, or $d = v$

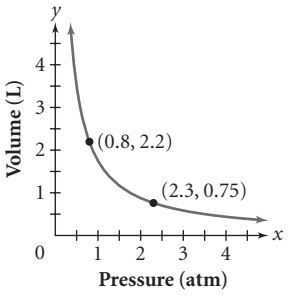
c. Inversely: $100 = vt$, or $t = \frac{100}{v}$

10. a. The product of the volume and the pressure is always $1.75 \cdot 1 = 1.75$. So, if the pressure is 0.8 atm, the volume is $1.75 \div 0.8$, or 2.1875 L.

b. $1.75 \div 0.75$, or $2.\overline{3}$ atm

c. $y = \frac{1.75}{x}$

d.



11. a. Start with a number. Double it. Subtract 1. Multiply by 3. Add 1.

b. x; $2x$; $2x - 1$; $3(2x - 1)$; $3(2x - 1) + 1$

c. $x = 4.5$; $2x = 9$; $2x - 1 = 8$; $3(2x - 1) = 24$; $3(2x - 1) + 1 = 25$

d. To find the starting value that gives a result at the last stage of 22, undo the steps listed in the answer for part a in reverse order:

Begin with the result, 22. Subtract 1 to get 21. Divide by 3 to get 7. Add 1 to get 8. Take half of 8 to get 4. Therefore, the starting value is 4.

12. To evaluate the expression $\frac{12 - 3(x + 4)}{6} + 5$ when $x = 1$, start with 1. Add 4 to get 5. Multiply by -3 to get -15. Add 12 to get -3. Divide by 6 to get -0.5. Add 5 to get 4.5.

13.

Equation: $\frac{12 - 3(x + 4)}{6} + 5 = 4$

Description	Undo	Result
Pick x.		2
+ (4)	− (4)	6
· (−3)	/ (−3)	− 18
+ (12)	− (12)	− 6
/ (6)	· (6)	− 1
+ (5)	− (5)	4

Improving Your Reasoning Skills

Answers will vary. One method is to work with the reciprocals of the rates stated in the problem. The information about guests and dishes translates into three ratios: $\frac{1 \text{ dish}}{2 \text{ guests}}$, $\frac{1 \text{ dish}}{3 \text{ guests}}$, and $\frac{1 \text{ dish}}{4 \text{ guests}}$. To find the total number of dishes, rewrite the ratios with a common denominator of 12 guests and add: $\frac{6 \text{ dishes}}{12 \text{ guests}} + \frac{4 \text{ dishes}}{12 \text{ guests}} + \frac{3 \text{ dishes}}{12 \text{ guests}} = \frac{13 \text{ dishes}}{12 \text{ guests}}$. So there were 13 dishes for every 12 guests. There were 65, or $13 \cdot 5$ dishes in all, so there must have been $12 \cdot 5$, or 60 guests.

Take Another Look

Answers for the first three graphs: $k = 1$, $k < 1 \left(= \frac{1}{2}\right)$, and $k > 1$ $(= 2)$. In the fourth graph, $k < 0$ $(= -1)$ because the quotient $\frac{y}{x}$ is negative for every point on the graph. In the last pair of graphs, the first set of lines is symmetric across $y = x$; the k-values are reciprocals $\left(3 \text{ and } \frac{1}{3}\right)$. The second set of lines is perpendicular; the k-values are negative reciprocals $\left(-3 \text{ and } \frac{1}{3}\right)$. The geometric relationship can be confirmed with similar triangles. If $k = 0$, the graph is the x-axis. By the definition of a direct variation, $y = 0$ is a direct variation. However, nothing is varying, so $y = 0$ would not usually be called a direct variation.